Factsheet

April 2023

The natural cycle of elements:

How nutrients and emissions released in the dairy chain are part of a cycle

The dairy sector by nature is a part of many circular production systems. Resources such as land, water, air, feed (inedible for humans), fertilizer and energy are used in a resource efficient manner to produce circular products such as milk, meat and manure. It is our responsibility and in our interest to use and maintain these resources in a long-term sustainable manner so that they are available to future generations.

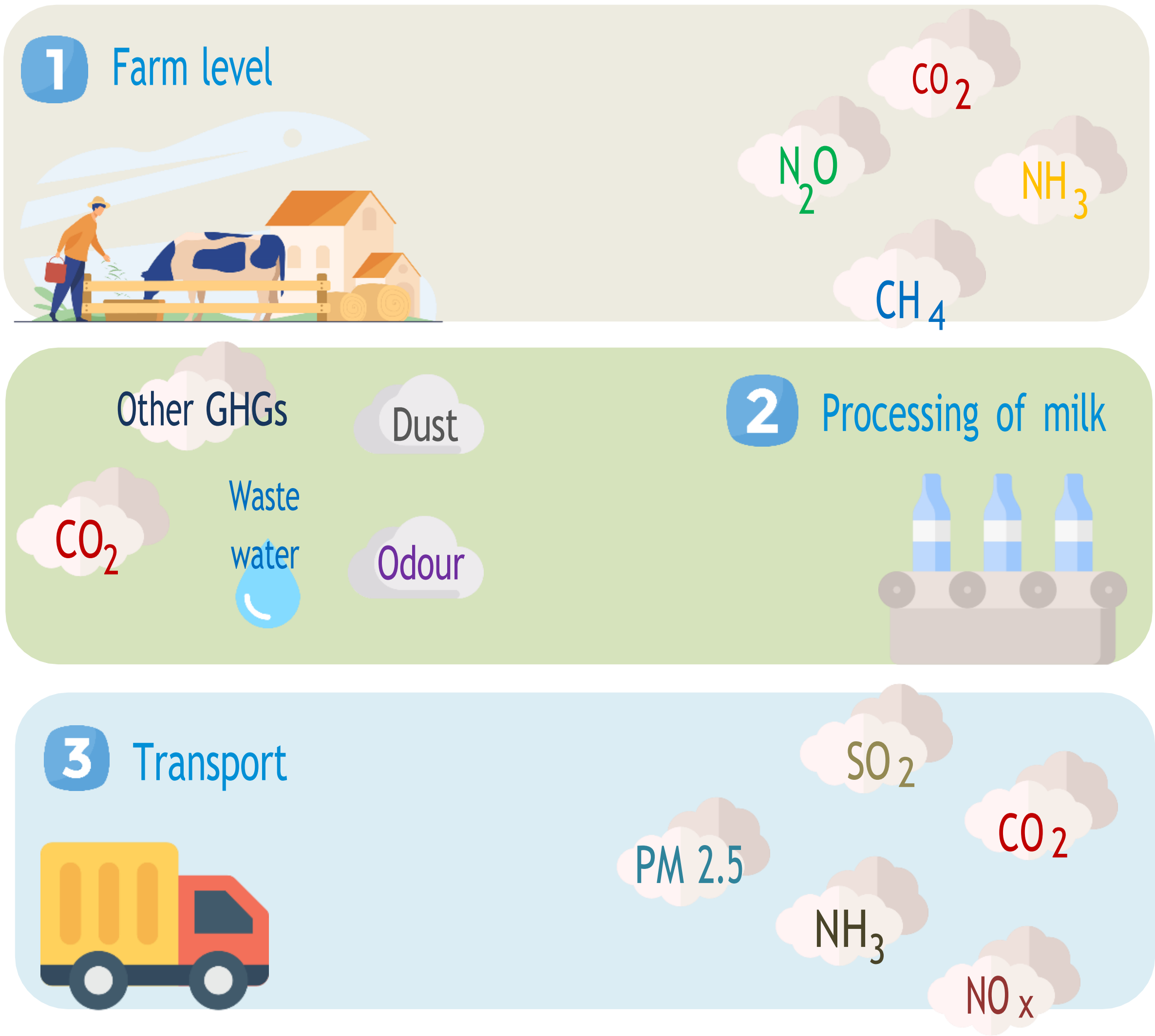
The dairy chain is very waste efficient and recycles naturally its resources but there is potential to improve efficiency even further at several levels in the production chain, as well as in retail and in consumer level. Emissions to air, nutrient losses to water and soil leaches occur at different stages in the production chain, i.e., farm, factory, retail, distribution and consumption.

What are emissions, nutrients and the diverse compounds we speak about?

The whole cycle of life is made of chemical compounds that are nutrients for different parts of the cycle: the human body, animals, plants and soil need different of these compounds to live and stay healthy. Nature and our planet keep us in the context of a closed cycle and assure release and stockage of nutrients in a balanced equilibrium.

We now know that certain human activities do not respect that cycle sufficiently and need to be changed. The term 'emission' is used for any compound released into the environment, be it part of a natural cycle or by human intention/ action; it has no positive or negative connection per se. What we all need is the live-essential compounds, also called nutrients. We wish to ensure the best possible use and re-use of all our resources, to keep humans' and nature's life healthy in the longer term.

I. Main emissions and nutrient losses across the whole dairy chain



(See in detail in table of chemical compounds, Annex I)

Sources

- Feed production (CO_2, N_2O, NH_3, P losses emissions).
- Enteric fermentation (CH_4).
- Manure storage and application (N20, CH_4 and NMVOC, NH_3, N_2O and NOx, nutrient losses to water, phosphates).
- Off-farm transport (CO_2, NOx and dust).
- Milk processing (CO_2, NOx, NH_3 and refrigerants (cooling systems and dust) nutrients losses to water).

Sinks

- Grassland and pastureland (CO_2 accumulation and storage).
- Improved resource efficiency – biogas production.

To know exactly where and to what extent nutrient losses occur all along the dairy chain we use the **Dairy Product Environmental Footprint (PEF)** methodology and adhere to the **legislation** of the European Union, which is the global leader in environmental requirements:

- **Land Use, Land Use Change and Forestry (LULUCF) and Effort Sharing Regulation (ESR):** cover emissions in the atmosphere of CO_2 and other GHG from dairy farms.
- **Emission Trading Scheme (ETS):** covers emissions in the atmosphere of GHG from dairy installations above a specific capacity threshold.
- **Industrial Emission Directive (IED):** covers emissions to air of non-GHG and losses to water in dairy processing sites (with a proposed future extension to livestock farming).
- **National Emission Ceilings (NEC)** Directive: covers emissions of ammonia (NH_3) from dairy farms.
- Additional national and regional legislation about phosphorous and other nutrients, depending on the regional conditions.

II. How have we achieved emission improvements and reduced nutrient losses?

With the efforts of all the actors across the dairy chain, many measures to limit the emissions to air and nutrient losses to water have been implemented.

A broad spectrum of measures towards improvement:

- ✔ Improvement in farm efficiency and better agricultural practice to increase productivity and resource efficiency and to reduce GHG emissions, for instance through grassland and crop management, improved harvesting and feed conservation practices, and reduction in feed losses.
- ✔ Improvement in animal health, welfare, breeding and milk waste reduction.
- ✔ Animal feeding solutions to reduce methane emissions from enteric fermentation

Energy production on farm

- Renewable energy production by solar panels, wind turbines and anaerobic digestion.
- Energy efficiency measures to reduce usage of fuels and electricity.

Sustainable transport

- Fossil-free fuel and more efficient trucks, bigger vehicles (less rides needed for delivery).
- Logistic routes optimisation.

Manure and slurry solutions

- Better nutrient management, application of fertilisers and manure considering rates and timing to reduce losses.
- Barn and manure storage design.
- Manure storage in covered slurry containers.
- Application techniques: underground application of solid manure, slurry injection.
- Biogas from manure to generate heat, power and vehicular fuel.
- Slurry acidification.

- Promotion of soil organic matter and soil carbon storage through efficient carbon farming practices aimed at preserving and enhancing carbon sequestration of pastureland.
- Conservation of existing EU carbon stocks in dairy grassland (one third of EU agricultural land is used for permanent grassland and meadows)
- Hedgerow management and agroforestry

- Increased feed production on-farm.
- Reliance on roughage (soy represents only a minor source of protein to dairy cows. In EU, on average, more than 85% of the feed volume of dairy cows is roughage, and 70% of the protein input stems from this sustainable type of fodder, which is almost entirely grown on farm).
- For the share of protein input via soy, increase in the responsibly produced soy use through sustainable schemes such as the Round Table on Responsible Soy (RTRS) or equivalents.
- Potential to lift by product use – i.e. cows eat what humans cannot.

III. Which is our progress so far?

The European dairy sector has significantly reduced its emissions in the past decades[1]. For instance, the carbon footprint per produced unit of milk in Europe is already among the lowest in the world and the sector is fully committed to further decrease its carbon intensity and contribute to the achievement of the EU GHG emissions reduction goals. Here are our main results so far, at EU level[1]:

From 1990 to 2020

- **27%** reduction in methane emissions from dairy enteric fermentation
- **13%** reduction in GHG emissions from dairy manure management
- **85%** increase in milk production/cow (kg milk/cow/day)
- Reduction in ammonia emissions, contributing to the overall downward trends of the European Union Members States

IV. Focus on climate

GHG emissions reduction is currently in the focus of EU environmental strategies, which are aimed at reducing net GHG emissions by 2030 and achieving carbon neutrality by 2050.

Climate evaluation is one of the many components of the nutrient cycles on earth, the one relating to GHG. It is important to realise that action on only one component is important, but not sufficient for a true move towards a more supportive environmental action. It is important to keep the complexity of many environmental indicators to make a credible change.

[1] EEA Annual European Union greenhouse gas inventory 1990–2020 and inventory report 2022 Submission to the UNFCCC Secretariat – May 2022

Methods of calculation

The current method of calculating the contribution of the different GHGs to climate change is the Global Warming Potential (GWP) methodology, which describes the amount of heat absorbed by a specific molecule of gas in the atmosphere, taking as reference the heat absorbed by an equivalent mass of carbon dioxide (CO2) within a specific timeframe (usually 100 years).

Global warming potentials

Chemical compound	Global Warming Potential – GWP (100 years)	Lifetime (years)
Carbon dioxide (CO2)	1	Hundreds
Methane (CH4)	29.8[2] (fossil origin)	11.8[2]
	27.0[2] (non fossil origin)	
Nitrous oxide (N2O)	273[2]	109[3]

However, recent studies have shown how the current way to calculate the GWP might overestimate the warming effect of methane, by not correcting for the shorter lifetime of methane in the atmosphere. In fact, current metrics do not recognize its breaking down in the atmosphere over the course of 12 years, while other GHGs, such as CO2 produced by the combustion of fossil fuels, can remain in the atmosphere for hundreds of years.

There is currently a clear movement by scientific experts (amongst others work of the Oxford Martin School with IPCC author Prof Myles Allen[3]), political groups and the industry (such as the Global Dairy Platform – GDP[4]) towards the re-examination of the GWP of methane - particularly biogenic methane from ruminants, in order to determine its true impact on the climate.

In this context, the EU Commission would need to further reflect upon the scientific basis and the current metrics for calculating the climate impact of greenhouse gases before deciding on actions, to assure true change in the right direction for the safeguarding of our planet.

[2] IPCC Sixth Assessment Report (AR6) - 2021
[3] A solution to the misrepresentations of CO2-equivalent emissions of short-lived climate pollutants under ambitious mitigation – June 2018

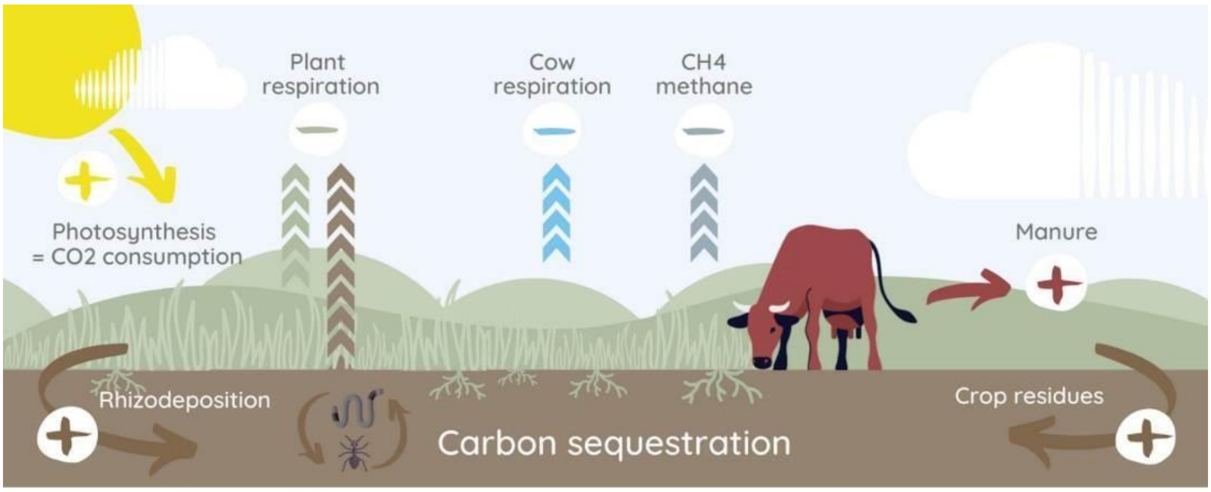
[4] GDP – A literature review of GWP* - 2020

Carbon sequestration: our big contribution to climate action

Nature-based solutions that capture carbon from the atmosphere can help the EU achieve climate neutrality and should therefore be rewarded. Carbon sinks such as permanent grasslands and forests will play a key role in the transition towards a carbon neutral continent by 2050.

Dairy producers can help reduce the greenhouse gas impact of their operations through efficient farm management which promotes soil carbon storage and absorption. Permanent grassland keeps carbon in places where else nothing could grow while efficiently providing essential nutrients to cattle. Compared to arable land, a lot of carbon is stored in grasslands and shifting land use from dairy to arable food production results in significant emissions due to the release of these stocks. Moreover, many of the soils managed by dairy farmers are prone to soil degradation (marginal lands). They are either unfit for arable use or sensitive to soil degradation when used for other purposes (even nature).

In addition to carbon storage, carbon sequestration of pastureland can offset a significant share of dairy livestock emissions[5]. Many existing projects at dairy farm level in Europe are aimed at enhancing carbon sequestration through developing reliable calculation methods and implementing carbon farming practices. EDA has also worked with the European Commission on exchanging best practices and contributing to the analysis and mapping of carbon farming approaches across Europe.



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[5] "The Dairy Sector and the Green Deal" – December 2019

The amount of CO_2 which is stored by dairy pastureland can have a key contribution in offsetting some of the environmental footprint of dairy products and it should be adequately included in all methodologies calculating the impacts.

However, carbon sequestration values are difficult to assess, depending on many variables such as soil quality, climate, etc, and many different methodologies are currently used for the calculation of the carbon sequestration potential of dairy pastureland. In order to address this, coordination is currently ongoing within the dairy sector to clarify the methodology and assessment of the carbon removals by dairy grassland in different geographical areas.

Moreover, the European Union is working on a legislative framework for the certification of carbon removals with the aim to establish a voluntary carbon market for trading credits obtained from the implementation of carbon farming practices in Europe.

Carbon farming

Carbon farming can be defined as a new green business model rewarding land managers for the implementation of improved management practices, resulting in enhanced carbon sequestration in farmland.

Agricultural practices that sequester carbon from the atmosphere into the soil could generate "carbon credits" (emissions that can be used to offset). Carbon farming credits could become an additional "product" that could be sold by land managers, in the context of a carbon market. Such credits can be bought by operators/individuals willing to reduce/offset their emissions.

In the context of the EU Farm to Fork strategy, the European Commission is proposing a voluntary market for carbon credits produced by European land, in which land managers are rewarded for the implementation of climate-friendly agricultural practices. This framework is meant to contribute to the achievement of the EU wide target for climate neutrality, and particularly the target set by the LULUCF regulation.

The carbon farming system could represent the opportunity for the industry to offset emissions within the value chain (also called "insetting"), but it must be economically viable and must not compromise food security, safety, quality and affordability.

V. What is our vision for the future?

The dairy sector is working to ensure that its operations remain sustainable in the years ahead. European dairies are frontrunners at global level when it comes to climate action. Many dairy industries have already signed up for the commitment of a carbon neutral dairy chain by 2050 or even 2035, with examples of carbon-neutral certified companies already in 2019. Moreover, many dairy companies have emissions reduction targets for 2030 or earlier, covering emissions from dairy processing and from the upstream and downstream phases of the dairy chain. In addition, companies also collaborate with B2B partners and launch products and labels with more sustainable dairy.

Dairies also stimulate and reward farmers on environmental topics. Most companies have trainings for farmers and communication materials. Some dairy companies also pay farmers for good performance on GHG and nutrient losses reduction.

According to the projections of the European Commission, GHG emissions from dairy (mainly CH_4 from ruminants' digestion and manure management) are foreseen to further decrease in the next decades while productivity is projected to increase[6].

However, the share of grassland area compared to arable land is expected to further decline by 2025. This will potentially lead to negative environmental impacts on GHG emissions from land-use change, as arable land has a lower soil organic carbon content and a lower biodiversity compared to pasture[7]. This highlights one of the beneficial impacts on the environment and climate of dairy farming compared to arable production.

The role of the Dairy PEF

EDA is proud to highlight the relevance of dairy in the wide context of environmental actions–including climate, but also looking to the broader picture with water and land uses, biodiversity and animal welfare. It is important to make climate action happen, but we should not forget that the dairy industry is looking at the overall environmental assessment from a more general point of view – to assure we do not improve on climate indicators while at the same time negatively impacting on other sustainability topics e.g. water or land use, food waste, animal welfare, good living for our farmers (social-economic component) or packaging. To do so, the dairy sector has developed the Dairy PEF (product environmental footprinting methodology),

[6] EU Agricultural Outlook report 2019 – DG AGRI

[7] EU Agricultural Outlook report 2015 – DG AGRI

harmonising carbon/climate assessment as well as 15 other environmental indicators. These indicators assess the impacts on a broad set of environmental components: if we consider water, for instance, it covers water use, eutrophication, ecotoxicity and acidification.

The below figure shows, for the product category "liquid milk", the repartition of the environmental impacts at the different stages of dairy production and consumption on the environmental components covered by the PEF. It allows to take a holistic approach when assessing the overall impact of dairy products, avoiding misleading results when focussing on single environmental components.

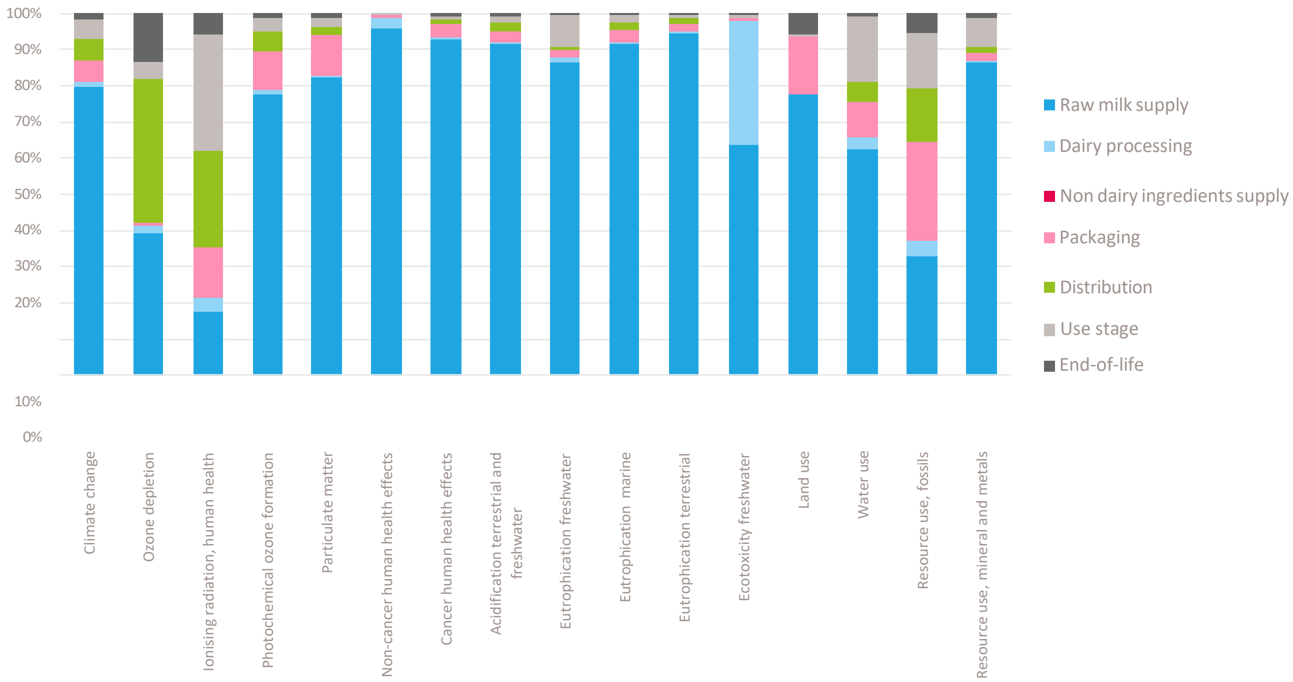

Figure: Profile of the PEF results for the product "Liquid Milk", assessing the contribution of each phase of the supply chain to the different environmental impacts.

Check also our EDA factsheet on the Dairy PEF.

European Dairy Association

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Annex

Table of chemicals compounds

Chemical formula	Chemical compound
CO_2	Carbon Dioxide
CH_4	Methane
N_2O	Nitrous Oxide
NH_3	Ammonia
NMVOC	Non-methane volatile organic compound
NO_x	Nitrous Oxides
P	Phosphorous
PM 2.5	Particulate Matter 2.5
SO_2	Sulfure Dioxide